

Robotics and Automation

B.E. Sem. VIII [ETRX]

EVALUATION SYSTEM

| | Time | Marks |
|-----------------------------|--------|-------|
| Theory Exam | 3 Hrs. | 100 |
| Practical & Oral | – | – |
| Oral Exam | – | 25 |
| Term Work | – | 25 |

SYLLABUS

- **Objective**

This course familiarizes students with the concepts and techniques in robot manipulator control and in hardware components for automation like Programmable Logic Controllers and also confident enough to evaluate, choose and incorporate robots and PLC in engineering systems.

- **Pre-requisite**

- 1) Matrix Algebra
- 2) Fundamentals of Image Processing
- 3) Fundamentals of Controllers

- 1. Introduction to Robotics**

Automation and Robots, Classification, Application, Specification, Notations.

- 2. Direct Kinematics**

Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Co-ordinates, Link co-ordinates, Arm equation ((Three axis, Four axis, and Five axis robots)

- 3. Inverse Kinematics & Workspace Analysis**

General properties of solutions, Tool configuration, Inverse Kinematics of Three axis, Four axis and Five axis robots

Workspace analysis of Four axis and Five axis robots, Work envelope, Workspace fixtures.

- 4. Trajectory Planning and Task Planning**

Trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

Task level programming, Uncertainty, Configuration space, Gross motion planning, Grasp planning, Fine-motion Planning, Simulation of Planar motion, Source and goal scenes, Task planner simulation.

- 5. Robot Vision**

Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transformation, Structured Illumination.

- 6. Programmable Logic Controller**

Discrete-State Process Control, Relay Controllers background, hardwired control system definition, Ladder Diagram Elements and examples, Relay Sequencers, advantages of Programmable Logic Controller (PLC), Evolutions of PLCs , Block diagram of PLC system – symbols used – relays and PLC Software Functions, logic functions – OR, AND, Comparator, Counters review, PLC Design, PLC Operation, Programming of PLCs – different methods – ladder STL and CSF, ladder programming of simple system like traffic light controller, conveyers, list of various PLCs available.

Reference Books :

1. Fundamentals of Robotics-Analysis and control (*Robert Shilling*) Prentice Hall of India
2. Robotics (*Fu, Gonzales and Lee*) McGraw Hill
3. Introduction to Robotics (*J.J, Craig*) Pearson Education
4. Process Control Instrumentation Technology (*Curtis D. Johnson*) PHI Publication, Eighth Edition
5. Robotics and AI (*Staughard*) Prentice Hall of India
6. Industrial Robotics (*Grover, Wiess, Nagel, Oderey*) McGraw Hill
7. Robotics and Mechatronics (*Walfram Stdder*)
8. Introduction to Robotics (*Niku*) Pearson Education
9. Robot Engineering (*Klafter, Chmielewski, Negin*) Prentice Hall of India
10. Robotics and Control (*Mittal, Nagrath*) Tata McGraw Hill publications
11. Programmable Controllers (*George L Balten Jr.*) Tata McGraw Hill publications

